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M. no. 20). Attention is called to the value of mushrooms and puffballs for food by L. M. Underwood (Ala. no. 73) in ten pages. Specific description is accorded *Agaricus campestris*, *Amanita Cæsarea*, said to be common in Alabama, and its poisonous relative *A. muscaria*. A chemical study of the Irish potato by T. L. Watson (Va. nos. 55 and 56) contains some facts of interest to vegetable physiologists.—J. C. A.

NOTES FOR STUDENTS.

MR. THEO. HOLM, in the continuation of his morphological and anatomical studies in the Cyperaceæ, has recently investigated *Carex Fraseri*,⁴ a very rare and local sedge with an appearance so peculiar as to distinguish it easily from other species of *Carex*. His results still further emphasize this distinctness. "The monopodial ramifications of its rhizome, with its single assimilating leaf destitute of sheath, ligule, epidermal expansions and bulliform cells, in connection with its flat and hollow stem, besides the uninterrupted pericambium of the root, constitute a structure that seems almost unique in the family of the Cyperaceæ."—J. M. C.

AN INTERESTING CONTRIBUTION to the subject of rhythm in plants is afforded by L. Jost's recent work on *Mimosa*.⁵ This plant is one of the few known examples in which etiolated leaves are irritable, and which exhibit periodic movements. In the experimental work etiolated leaves were obtained by enclosing the tip of a branch in a dark chamber. The periodic movements of the enclosed etiolated leaves were not induced by impulses from the free leaves, since artificial alterations in the periods of illumination and darkness of the latter produced no variations in the movements of the enclosed organs. The periodic movements of green as well as etiolated leaves of *Mimosa* are due largely to variations in temperature. Rise in temperature causes the leaves to assume the night position, and a fall in temperature the day position; exactly the reverse of the relations of flowers to temperature. This fact is remarkable in view of the fact that leaves and flowers react alike to changes in the intensity of light.—D. T. MACDOUGAL.

MR. T. CHALKLEY PALMER has succeeded in demonstrating, by a very simple device, that diatoms absorb carbon dioxide and exhale oxygen under the influence of light. While these indications of photosyntax were not needed to prove that diatoms are plants, the simplicity of the device makes the demonstration an easy one to employ in illustrative work. Advantage is taken of the fact that an ordinary aqueous solution of haematoxylin loses its

⁴ Am. Jour. Sci. IV. 3 : 121-128. *pl.* 4. 1897.

⁵ Ueber die periodischen Bewegungen der Blätter von *Mimosa pudica* in dunkeln Raume. Bot. Zeit. 55 : 1 Abth. Hft. VI, Feb. 16, 1897.

"normal rosy or slightly bluish-red tint," when exposed to carbon dioxide, and becomes "yellow with a tinge of brown;" and "in the presence of nascent oxygen the light red hue deepens momentarily and ends by becoming a very deep blood red." In a properly guarded test tube a solution of haematoxylin is placed which has been acidified with carbon dioxide. Into the brownish-yellow liquid living diatoms are placed and exposed to bright light. Gas arises, and within fifteen minutes the color has become quite red, continuing to deepen in color until it is blood red. By using two tubes filled with normal reddish solution of haematoxylin, and placing a living snail in one and diatoms in the other, the former pales rapidly under the influence of the carbon dioxide from the snail, while the latter rapidly darkens and reddens. In all cases, of course, other tubes containing the solution are used as checks.—J. M. C.

DR. ANTON HANSRIG⁶ has recently investigated the ability of pollen to resist water, and the relation between this power and the protection against rain and dew. Since many plants whose pollen grains and sporophylls are fully protected against rain and dew have very resistant pollen, and, on the other hand, plants with exposed sporophylls often have pollen very sensitive to moisture, he considers Lidforss' parallelism between protection against rain and the resistance power as questionable. Although the cohering pollen of many plants needs protection against too early wetting, there are many entomophilous plants whose pollen can withstand wetting without injury. In different families and genera there are many intermediate forms between these and those with pollen very sensitive to moisture. The author gives a long list of plants whose pollen germinates well in pure water, but whose sporophylls are not protected against wetting. Another list includes those whose sporophylls are protected against wetting, but whose pollen germinates thoroughly in pure water. Plants whose pollen germinates poorly or not at all in pure water will be noted later, the present paper being a preliminary statement.—C. J. C.

J. M. JANSE has published recently an account of his researches upon root endophytes.⁷ He examined forty-four dicotyledons, fourteen monocotyledons, five gymnosperms, and six cryptogams. In these cases the endophyte failed to appear in but one dicotyledon, three monocotyledons, and two cryptogams. The plants studied were taken almost entirely from natural conditions, and many specimens of each type were used in order to avoid exceptional cases. The superficial roots are inhabited more often than the deeper ones. A filament of the fungus forces its way through the epidermis, and usually without branching passes directly through the outer layers of cells. Then the hypha

⁶ Zur Biologie des Pollens. Oesterreichische Bot. Zeitschrift 47: 48-52. 1896.

⁷ Ann. Jard. Bot. Buit. 14: 53-202. 1896.

branches rapidly and invades the tissue longitudinally. In this region of branching many "vesicles" are formed. It is thought that these "vesicles" may be cysts which germinate when they are freed by the disintegration of the root. Usually the fungus penetrates deeper than the region of "vesicles," and forms "sporangioles." These are not reproductive bodies, but disintegrate soon after formation. They are formed within cells only, while the "vesicles" may be either in cells or intercellular spaces. The fungus never penetrates the endodermis, and usually stops with one or two layers of cells separating them. It never enters cells which contain no nutritive substances, and evades scrupulously those which contain such substances as tannin and resin. It seldom enters cells containing chlorophyll; but in a few cases where aerial root cells contained chlorophyll on one side, the endophyte was found to occupy the other side of the same cells. The fungus nourishes itself with the starch grains of the infested cells and those adjacent to them. This loss of starch marks the only possible detrimental effect in the host cells.

The systematic affinities of the endophyte are absolutely unknown, although several authors have described it or some similar form. Jansen claims that none of the forms so described can be the one which he presents. There is variation in the structure of this endophyte in different hosts, but the "guest" seems to maintain its identity sufficiently throughout its various habitations. The slight morphological differences do not necessarily indicate physiological differences.

The author thinks the association of the endophyte with its host one of mutualism ("commensaux"). He likens it to such conditions as exist between *Rhizobium* and the root tubercles of the Leguminosæ, and *Saccharomyces Kefyr* and *Bacillus Causasicus*. The endophyte evades free oxygen, as is shown by its aversion to chlorophyll cells. The host plant gives it a hiding place, and it is also furnished with food in the form of starch. The nuclei of the host cells in which the "sporangioles" are breaking down become very large and divide rapidly, giving evidence of being well nourished by the nutritive matter of the "sporangioles." The host cells use a large part of the nitrogen compounds of the "guest." Experiments upon coffee plants show that they grow best when their roots are inhabited by the endophyte.—O. W. C.

CENTROSOME LITERATURE has received a notable addition in the recent contribution of R. Lauterborn⁸ upon diatoms. Various species of *Surirella* and *Pinnularia* form very favorable objects for the study of centrosomes, since these bodies can readily be seen in *Surirella* even in the living condi-

⁸ Untersuchungen über Bau, Kernteilung und Bewegung der Diatomeen: Aus dem zoologischen Institut der Universität Heidelberg. Leipzig, 1896.

tion. The author's investigations on this point are exceedingly interesting. There is one centrosome which lies in a depression beside the resting nucleus. The centrosome appears "naked" in the living condition, no attraction sphere being seen around it. The author agrees with Häcker that the attraction sphere is an artificial structure produced by plasmolytic contraction of the centrosome. While the nucleus is in the resting stage there are no radiations around the centrosome; but when nuclear division begins the centrosome passes out of the depression and becomes surrounded by exceedingly well defined radiations, which appear as definite in the living state as in fixed preparations or more so. There is a close relation between the centrosome and nucleus, which becomes apparent when the nucleus is forcibly removed from the cell. In this case the centrosome remains attached to the nucleus even if all the cytoplasm from both has been torn loose. The fact that the centrosomes, as in *Surirella*, can be seen plainly in living cells is a strong argument against the temporary organ hypothesis. The centrosome is a kinetic center from which, at the beginning of nuclear division, activities proceed out upon the nucleus and cytoplasm, which appear morphologically as radiations around the centrosome. When the radiations appear a new body arises in close proximity to the centrosome, which is the beginning (*Anlage*) of the central spindle. This body appears to come from the centrosome by division or budding, although the process was not observed. The central spindle body soon increases in size and begins to pass through a series of peculiar forms. It elongates and becomes sheaf shaped, and when the nuclear membrane has disappeared, it enters into the nucleus, and the chromatin segments arrange themselves about its equator and are then carried to the poles. The author has very carefully observed that the central spindle body is not to be confounded with a nucleolus. Before the central spindle enters into the nucleus the centrosome begins to vanish. During the formation of the daughter nuclei a centrosome appears at each end of the central spindle, and when the nucleus is about completed a centrosome lies in the nuclear depression at the central point of the cytoplasmic radiations. At this stage nothing more is to be seen of the constricted ends of the spindle. Their substance is very likely withdrawn into the centrosomes. The origin of the two centrosomes at the poles was not definitely determined. Either secondary centrosomes are formed at the two poles of the central spindle whereby the original centrosome goes to pieces, or, since the original centrosome is always near at hand, the two dark hemispherical bodies which appear on both sides of the central spindle may be formed by division of the original centrosome, and these two bodies later become differentiated into new centrosomes, one for each daughter nucleus. The whole nuclear and cell division in *Surirella calcarata* was completed in from five to five and one-half hours.—J. H. S.

ITEMS OF taxonomic interest are as follows: In their continuation of Welwitsch's African freshwater algæ, Messrs. W. West and G. S. West describe three new genera;⁹ *Psephotaxus* (Ulotrichaceæ), *Temnogamctum* (type of a new family of Conjugatæ, in which conjugation occurs only between specially abstricted cells), and *Pyxispora* (Zygnemaceæ). Bulletin 4 of the Division of Agrostology contains a revision of the genus *Ixophorus* by F. Lamson-Scribner; a list of the grasses collected by Dr. Palmer near Acapulco, Mexico, in 1894-5, among which is a new genus *Fourniera* (Zoysieæ), by the same author; some Mexican grasses collected by E. W. Nelson in 1894-5, by F. Lamson-Scribner and Jared G. Smith; some American *Panicums* in the Herbarium Berolinense and in the herbarium of Willdenow, by Theo. Holm; native and introduced species of *Hordeum* and *Agropyron*, with keys, by F. Lamson-Scribner and Jared G. Smith; and miscellaneous notes and descriptions of new species, among which *Chatochloa* Scribner is proposed as a new generic name for *Setaria*, which is untenable for several reasons, and neither *Chamæraphis* nor *Ixophorus* is available as both are well-defined genera and abundantly distinct. Bulletin 6 of the Division of Agrostology gives a full account of the grasses and forage plants of the Dakotas, by Thomas A. Williams. Mr. P. A. Rydberg, in continuation of his studies of *Potentilla*,¹⁰ describes four new species. Miss Anna Mary Vail has published notes on *Parosela*¹¹ (*Dalea*), which include descriptions of three new species, besides the transfer of specific names. Dr. Charles Mohr has published notes on some undescribed and little known plants of the Alabama flora,¹² among which are new species of *Sagittaria* and *Oldenlandia*. Mr. Geo. V. Nash has described¹³ new species of *Erianthus*, *Paspalum*, *Panicum*, *Agrostis*, and *Danthonia*. A new *Prunus* from Connecticut, *P. Gravesii*, is described by Mr. John K. Small,¹⁴ and a new *Crataegus* from Virginia, *C. Vailiæ*, by Dr. N. L. Britton.¹⁵ In the continuation of the account of Welwitsch's African fresh water algæ,¹⁶ among the numerous new forms of Desmidiaceæ, W. West and G. S. West describe a new genus, *Ichthyocercus*. The February number of the *Bull. Torr. Bot. Club*¹⁷ contains descriptions of numerous new fungi, chiefly from Alabama, by L. M. Underwood; a new *Lechea* from Maine, by E. P. Bicknell; a new violet of the Atlantic coast and a new geranium, by N. L.

⁹ Jour. Bot. **35**: 33-42. 1897.

¹⁰ Bull. Torr. Bot. Club **24**: 1-13. *pls.* 287, 288. 1897.

¹¹ Bull. Torr. Bot. Club **24**: 14-18. 1897.

¹² Bull. Torr. Bot. Club **24**: 19-28. *pls.* 289-291. 1897.

¹³ Bull. Torr. Bot. Club **24**: 37-44. 1897.

¹⁴ Bull. Torr. Bot. Club **24**: 44. *pl.* 292. 1897.

¹⁵ Bull. Torr. Bot. Club **24**: 53. 1897.

¹⁶ Jour. Bot. **35**: 77-89. 1897.

¹⁷ Bull. Torr. Bot. Club **24**: 81-86, 86-90, 92-93, 93-94. 1897.

Britton; and a new *Ribes* from Idaho, by A. A. Heller. Mr. F. V. Coville¹⁸ has described a new *Collomia* from Oregon, and Mr. John B. Leiberger¹⁹ a new *Delphinium* and a new *Sambucus* from the northwest coast. G. Hieronymus²⁰ has begun the publication of the spermatophytes of the Argentine Republic, Uruguay, Paraguay, Brazil, and Bolivia, the first paper including the *Vernoniæ* and *Eupatoriæ*. The great display of these tribes to the south may be judged by the fact that over 200 species are presented, almost 100 of which are new. The three great genera are *Vernonia*, with fifty-six species, twenty-five of which are new; *Stevia*, with forty-five species, twenty-seven of which are new; and *Eupatorium*, with seventy-five species, twenty-six of which are new.—J. M. C.

ABOUT THREE YEARS AGO the Hatch Experiment Station published a bulletin upon the effect of the electric current in promoting the growth of plants, which was somewhat adversely commented upon in this Journal.²¹ The same station has now issued another bulletin dealing with the subject from another standpoint. The work was done by Asa S. Kinney,²² under the supervision of Professor George E. Stone, and relates chiefly to acceleration of growth during germination. Very few of the attempts to study the action of electricity upon plant life have made any substantial contribution to our knowledge of the subject. The present paper, however, appears to show that beyond doubt a small alternating current of moderate frequency and fairly high voltage when applied for a short time has a stimulating effect upon growth.

The experiments were in three series. In the first series 200 seeds of a kind, after being soaked in water for twenty-four hours, were divided into lots of twenty-five seeds each, and exposed to the electric current at different voltages for two minutes, with exception of one lot kept for comparison. Seeds of white mustard, red clover, rape and barley were used. The source of the current was four Leclanché cells, acting upon a secondary induction coil through a primary coil and interrupter. The results are shown in the number of seeds germinating at intervals of 24, 48 and 72 hours, and the average length of the radicles at the close. A second trial was carried out in the same manner, but using two Samson no. 1 battery cells, and continuing the treatment five minutes instead of two. A third trial was made in all particulars like the first trial but omitting the barley, and continuing the observations to a fourth interval of ninety-six hours, and measuring both radicle and hypocotyl. For the three trials 2200 seeds were used.

¹⁸ Proc. Biol. Soc. Wash. 11: 35-37. 1897.

¹⁹ Proc. Biol. Soc. Wash. 11: 39-41. 1897.

²⁰ ENGLER'S Bot. Jahrb. 22: 672-798. 1897.

²¹ 19: 88. 1894.

²² Electro-germination. Bull. Hatch Exper. Station, no. 43, 32 pp. Illust. 8vo. Amherst, January 1897.

The resulting data show a convincing uniformity. In all cases there was an increase in the rapidity of germination and elongation of the radicle and hypocotyl in the treated seeds, with a distinct optimum above and below which the treatment was less effective, although never injurious.

In the second series 100 seeds each of white mustard, rape and red clover were used in lots of twenty-five. The treatment was for two minutes. One lot received the current as in the first trial of the previous series using what had been shown to be the optimum voltage. The second lot was treated in the same manner except that the number of interruptions of the primary current was reduced from about 6000 for the two minutes to 10. The third lot received the direct current from the cells; and the fourth lot served for comparison, being untreated. Two trials were made, corresponding to the first and third trials of the previous series, 600 seeds in all being used.

The resulting data show a favorable effect from all three forms of treatment, there being small difference between them in hastening germination, but in growth of radicles and hypocotyls the alternating current of higher frequency giving best results.

The third series is not so fully reported as the others, but was equally satisfactory in results. It consisted in stimulating seedlings at regular intervals for some days, in order to see if beneficial effects would continue to be shown as the plants grew. The current was the same as in the first trial of the first series, and was passed through a funnel or flower pot of moist sand in which the seedlings were grown. By attaching the primary wires to a clock movement the current was set up for about thirty seconds at the beginning of each hour. In one trial seedlings of horse bean (*Vicia Faba*) were observed for two days, and in another trial seedlings of white lupine (*Lupinus albus*) were observed for fourteen days. Both trials gave increased growth.

These several experiments and their results are clearly and concisely reported, and in a form that makes the data valuable for study. The report is not accompanied, however, with any discussion of the physiological action of electrical stimuli, or of the philosophy of the mode of treatment adopted. These are very alluring topics, but must be passed over for the time being.—J. C. A.

THE EXPERIMENTS whose results are embodied in a late paper were begun on the influence of temperature upon the osmotic processes in living cells in 1892 by Professor Krabbe, but the manuscript was left unfinished at his death, and prepared for publication by Dr. Kolkwitz.²³

All attempts to prove with living cells, as was done with his artificial cell by Pfeffer, and in theory by von t'Hoff, that the osmotic pressure is propor-

²³ KRABBE, G: Ueber den Einfluss der Temperatur auf die osmotische Prozesse lebender Zellen. *Jahrb. f. wiss. Botanik* 29: 441.

tional to the absolute temperature, were unsuccessful, the turgor being too high at low temperatures. In investigating the influence of temperature on the rapidity of the osmotic movement of water more satisfactory results were obtained. It was found, for instance, that if cylinders of the pith of *Sambucus* 180.5^{mm} long were placed in a 24 per cent. cane sugar solution at 0 to 1°C., and at 20°C., the contraction in 2^h 15^m was to 176.5^{mm} in the former, to 147^{mm} in the latter; that is, at 20° more that eight times as much water had been given off as at zero, transverse contraction being neglected. Conversely, when pith was placed in distilled water at 4° and at 26°C., the elongation within 15^m was about four times as great in the latter as in the former. In experiments with roots (*Vicia Faba* and *Phaseolus multiflorus*) the difference was less, the ratio never exceeding 1 to 2.5 during the first five minutes, and decreasing with the duration of the experiment. The ratio of the amount of elongation of plasmolysed roots in distilled water at 4° and 26°C. was about 1 to 3 during the first ten minutes. Poiseuille's formula provides for an average increase in the viscosity of water of 0.034 for each degree C. above zero. Pfeffer's observations at 7.1°, 17.6°, and 32.5°C. suggest an increased rapidity of osmosis through copper-ferrocyanide membranes of 0.045 per degree, or from 1 to 1.9 with 20° increase. His own figures being considerably higher, Krabbe concludes that they must depend on the living nature of the protoplasm. At a low temperature, the condensation of the protoplasm makes it so resistant to the passage of water that if pith cylinders in ice water, whose elongation has ceased, be split, the halves become concave on the inner surface. In a certain sense the condition of the protoplasm here regulates the turgor without being pervious to anything but water.²⁴ Krabbe believes that at 24°C. the intermicellar openings are already large enough to permit some exosmosis of the cell content into pure water, but no figures are given in proof.

The increased inner friction of water when cooled, represented by Poiseuille's formula, may claim more or less of a share in the decreased rapidity of osmosis, as it is slightly or decidedly overshadowed by friction against the membrane. But the latter element is always present, and when 50 to 200 membranes obstruct the way it may well suffice to explain the difference of tensions at surface and interior of the pith cylinders. It is no more reasonable to expect different membranes to show like variation in this respect than to assume for all substances a common coefficient of expansion when heated. The resistance to filtration is an unknown²⁵ function of the diameter of the interstices. The finer these already are, the greater must be the effect of a given further decrease; so we should anticipate for protoplasm, impermeable to many substances, KNO₃ etc., which traverse the copper ferrocyanide membrane

²⁴ Cf. Pfeffer, Zur Kenntniss der Plasmahaut und der Vacuolen, etc. 302 [156].

²⁵ In capillary tubes of measurable size, the resistance varies with the fourth power of the radius; in the case in question the power is probably higher.

a considerably more marked response to changes of temperature than is displayed by the latter. This being so, it is unnecessary to refer the difference to the vitality of the protoplasm.

Essentially the same phenomenon described by Krabbe is that of bleeding, decreasing rapidly as it does with falling temperature, and usually ceasing some degrees above zero.

While in the life of the plant the protoplasm must permit the wandering of various food matters from cell to cell, and, therefore, be permeable to them under circumstances which we do not sufficiently understand, it is extremely doubtful if perfectly healthy cells ever permit exosmosis of anything except water when immersed at room temperatures. Determinations of turgor are ordinarily made at such temperatures, and though Krabbe does not carry his point so far, their accuracy would at least be shaken by the possibility of such a process. And as plants live and grow at such temperatures, what is to limit the filtration of the sap from the cells? That this does not occur so as to be appreciable by any test of plasmolysis, or measurement, unless by fine chemical reactions, needs no argument. That it does begin with injury to the protoplasm is a matter of common experience receiving critical attention from De Vries.²⁶

Last year the writer had occasion to determine very carefully the turgor of leaves of several mosses, and of the roots of *Vicia Faba* and other phanerogams at temperatures from 0° to 37°C., and while the temperature appreciably affected the time required for plasmolysis, it had not the slightest discernible influence on the ultimate result. These experiments covered a wider range of temperature than Krabbe's. The conditions were different in that practically all the cells were in immediate contact with the plasmolysing solution. And while the results confirm Krabbe's conclusion that the combined resistance of many layers of protoplasm is responsible for the difference of tension in cold water between the axis and periphery of pith cylinders, and for their failure to plasmolyse completely at 0°C., they are unfavorable to the idea of the filtration from the healthy cell of any of its turgor-producing contents. Any such action was a stage of death.

Finally the statement that pith in cold water does not stretch beyond its limit of elasticity holds good according to Kolkwitz²⁷ only when the time of immersion does not exceed four to six hours.—E. B. COPELAND.

²⁶ Bot. Zeit. 42: 289.

²⁷ Fünfstück's Beiträge zur wiss. Botanik, 1895.